REMARKS

This application was filed with 84 claims. Claims 4-32, 36-63 and 67-84 were canceled by preliminary amendment. Claims 1-3, 33-35, 64-66 and 85-95 have been rejected. All pending claims have been amended. Therefore, claims 1-3, 33-35, 64-66 and 85-95 are pending in the Application. Reconsideration of the application based on the claims as amended and arguments submitted below is respectfully requested.

Oath/Declaration

Applicant will submit a new Declaration that identifies the citizenship of each inventor as such time as this Application is determined to be in condition for allowance.

Specification

As noted in Applicant's response dated February 23, 2010, Applicant will submit a corrected Specification and new Abstract page at such time as the Application is determined to be in condition for allowance.

Claim Objections

The Examiner has objected to Claim 33 due to informalities on line 5 and line 28. These informalities have been corrected and therefore the Examiner's objections are rendered moot.

Claim Rejections - 35 U.S.C. § 103

Claims 1-3, 33-35, 64-66 and 85-95 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,692,761 to Robinton in view of U.S. Publication No. 2003/0097482 to DeHart et al. and U.S. Patent Publication No. 2003/0103521 to Raphaeli et al. For the reasons explained below, Applicant respectfully traverses these rejections.

The present invention concerns a package communication protocol between a collecting unit and a plurality of control devices along a power supply line. As an example, the present invention can be used with a public lighting system, such as a lighting system arranged along a network of streets in a city. Such a network may have a very large number of light emitting fixtures or points. Each light emitting point may have a control device which is capable of providing information about the operation of the lighting device and/or is capable of receiving instructions or commands from a collecting unit which also collects data or information coming from the various points of the network. The points of the network are connected to one another a common power supply line, i.e. by the utility electric grid. Communication between the collecting unit and the control devices is provided by messages transmitted on the power supply line, using a power line modem (PLM).

In such a network, the collecting unit may be physically located a significant distance apart from one or more remote control devices. Between the collecting unit and the most distant remote control device the network may include a large number of intermediate control devices connected to intermediate lighting devices.

The transmission protocol provides, among other features, for the transmission of messages addressed to a specific control device. In some instances, a message must be transmitted from the collecting unit to one of the most remote control devices. The message generated by the collecting unit must therefore travel a long path along the network. The network is, as stated above, the power supply line itself. Due to external interference (EMI disturbances for example) that may be caused by other devices coupled to the line, a high level of noise may be present on the power supply line. This noise might prevent the message from properly reaching the remote control device. According to Claim 1 of the present application, this problem is solved as explained below.

When a message that is addressed to a specific control device must travel along the supply line, each control device on the network which receives that message will generate an echo of the message if it recognizes that the message is not addressed to itself, i.e., if it is not the intended addressee of the message.

Assume, for example, that a collecting unit transmits a message addressed to a control device N900 along a power supply line. Also assume there are another thousand devices connected to the power supply line. Not every control device will receive the message because of the noise on line. Only the devices that are positioned near the collecting unit and/or which are located in a section of the power supply line where a lower level of noise is present will receive the message which is addressed to control device N900.

Assume further that the device N900 (the addressee of the message) does not receive the message directly from the collecting unit, either because it is too distant from the collecting unit, because too much noise is present on the line, or because for some reason a section of the power supply line has too high an impedance at the frequency at which the message is transmitted. Each device on the power supply line which receives the message and understands, from the address of the actual addressee included in the message, that the message is not addressed to it, will generate an echo of the message.

In accordance with one aspect of the invention, an echo of the message is an exact copy of the original message which is re-transmitted on the power supply line from the control device generating the echo itself. In some instances, the echo differs from the original message by a flag or a counter, which is either increased or decreased at each iteration of the transmission process. However, the echo is identical to the original message as far as the address of the sender and the address of the intended recipient are concerned, as well as far as the payload is concerned. That is, the actual information content of the message will be transmitted from the sender to the recipient.

In the present invention, an echo of the message must be a copy of the message itself (in the sense discussed above), and not something different. In particular, the addressee (i.e. the address of the device for which the message is intended) is not changed. Otherwise, there would not be an echo of the original message, but rather a different message.

The purpose of echo generation is to move the message forward along a power supply line so that the message will reach a control device which is arranged a substantial distance from the collecting unit. This is accomplished by repetition of the message (i.e. the echo generated) provided by intermediate control devices arranged between the collecting unit and the control device to which the message is addressed.

Each control device which receives the message and is not the intended addressee will not generate a new message with a new addressee and will not send that message to a specific control device. <u>It will simply regenerate the same message addressed to the same addressee, i.e. it will generate an echo of the message.</u>

When the intended control device to which the original message was addressed (i.e. the actual addressee) receives the message, that addressee will generate a responding message. The responding message is again transmitted along the power supply line until it reaches the collecting unit. This back transmission is performed with the same logic as for the forward transmission of the message from the collecting unit to the remote control device.

The same criteria will apply if for some reason messages must be exchanged between two different control devices, rather than between a control device and the collecting unit.

The first message and the response to that message generated by the intended addressee are linked by information in the message itself. For example,

the first message includes a message counter containing a sequence number and the responding message contains the same counter increased by 1.

This means that each control device on the power supply line which receives the response to the original message understands that the new message is indeed a response to the original message from the collecting unit to the remote control device. Each control device on the supply line will therefore understand that the addressee has been reached by the original message, because it has reacted by generating a response thereto. Such situation is interpreted by each control device on the supply line as an indication that no further echoes are required for the original message, that is, the original message was duly received and has been processed by the intended recipient.

However, if for any reason the intended addressee, i.e. the remote control device to which the original message is addressed, does not respond (for example because there is an interruption in the supply line or the control device is broken), in the absence of any countermeasure each control device on the supply line would continue to generate echoes of the original message.

If there are hundreds of devices on the supply line, and if there is one failure of one control device, all the other devices will continue indefinitely to generate echoes of the same message thus creating a jam on the transmission line. If this happens, resources of each device would be dedicated to a useless processing of echoes. Also, transmission of useful further messages would be impaired by the bus

being busy with the old and useless echo of a message which is intended for a dead control device.

To prevent such a situation, according to Claim 1 of the present application, the control device compares the message with pre-established criteria and transmits the echo of the message upon determining that such message corresponds to those criteria to prevent a limited generation of echoes of a given message.

Having further explained the features of Applicant's Claim 1, the flaws in the cited prior art can be more easily understood.

The Office Action states that the primary reference (Robinton) discloses "transmitting an echo of the received message". <u>This is not correct</u>. Referring to Fig. 2 of Robinton and the text at column 7, line 59 to column 9, line 66, the transmission protocol disclosed in Robinton provides that a message is transmitted from a master unit 24 to an intended addressee node and backwards, or vice-versa along a pre-established path defined by the preferred uplink or downlink path. The downlink path is the path from a node to the master unit. The uplink path is the opposite, from the master unit to the node.

The preferred path as disclosed by Robinton is defined by the sequence of nodes through which a given message should be transmitted from the generator of the message (for example a node 26 on Fig. 2) to the recipient of the message (for example the master unit 24). The cited text in the Robinton specification clearly discloses how this process operates. When a node must transmit a message on the network, it writes in the message data identifying the final intended addressee of

the message (e.g. the master unit 24). Furthermore, the message generating node also includes in the message the address of the next node along the preferred downlink path in the network. The message, therefore, is not addressed directly to the final intended recipient, but rather to the preferred intermediate node of the network. The intermediate node is selected based on the structure and condition of the network to which the nodes are connected.

The intermediate intended node receives the message and does not generate an echo of that message. Rather it sends on the line a different message. The information (payload) is the same and the final addressee is the same but a new address for a further intermediate node along the downlink path is introduced. This new message, which is an echo of the original one, will be transmitted for the intended recipient, which is the second node along the preferred downlink path.

The process is repeated for every node along the downlink path which has been defined according to the current situation of the network, for example according to the higher or lower level of noise along the various branches and sections of the network.

Thus, there is a basic and conceptual difference between the Robinton method and the claimed invention which is that in the claimed invention there is no preferred up-link or down-link path. Each device is equally ranked in the system. Each device will either receive or not receive the starting message, for example an interrogation message from the collecting unit. Those devices which are sufficiently near to the collecting unit and/or which are connected to the collecting unit by a

section of the power supply line with a low level of noise or low impedance will receive the message. Some of the control devices will not receive the message because they are either too far away or too much noise is present on the portion of the supply line connecting that control device to the collecting unit.

If the intended recipient of the original message coming from the collecting unit receives the message promptly, i.e. when the collecting unit writes and sends it on the power line, it will reply to the message and no echoes will be generated, because each one of the remaining devices will see that both the original message and the response thereto have been transmitted on the line. This implies that the intended recipient of the original message has received and reacted to the message.

If this does not occur, i.e. if the intended recipient is not reached by the first transmission of the message from the collecting unit, all the other devices on the line (which receive the message) will each generate an echo of the starting message. As noted above, an echo of the starting message is a copy of the message, in which <u>the final destination (i.e. the addressee or intended recipient) of the message is not changed</u>. This process is repeated again and again until the message reaches the remote intended recipient. The echo repetition procedure is interrupted once the response to the original message is read by the intermediate nodes or control devices or when the criteria set forth in the last paragraph of Claim 1 is not met.

The drawings below are provided to better clarify this conceptual difference. In Fig. A the transmission protocol disclosed by Robinton is used. In Fig. B the

same network as in Fig. A is depicted, but the transmission protocol of the present invention is used.

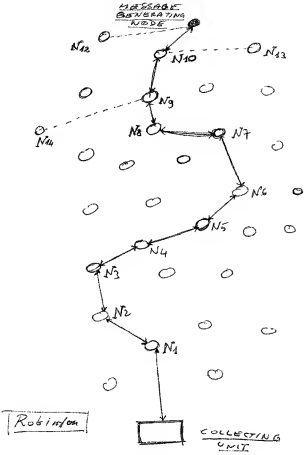

Fig. A

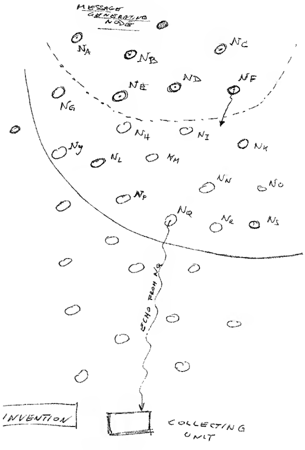

Fig. B

In both Fig. A and B the following situation is depicted: a plurality of nodes (each one including, for example, a control device as claimed) is provided in a network. Each node is connected to the network. The connections between the nodes are not represented in the drawings for the sake of simplifying the representation. The connections between the nodes are provided by a power supply line. Transmission

of messages is performed by a power line modem provided on each node. A collecting unit, which corresponds to the master unit 24 in Robinton, receives messages from the various nodes and/or transmits messages to the various nodes. Each node has its own address and each/every message includes the addressee of the message to which the message is intended, i.e. the final destination of the message (the intended recipient of the message). The message can be generated by one of the nodes (i.e. one of the control devices connected to the power line) or by the collecting unit.

In both Fig. A and B, thee is indicated a generic message generating node in the most remote region of the network, i.e. in a position distant from the collecting unit.

According to the protocol disclosed by Robinton (Fig. A), the transmission of a message from the message generating node to the collecting unit is performed as follows: Each node knows which is the preferred downlink node for the transmission of a message. The preferred downlink node is determined in a preliminary assessment step, based on the condition of the power supply line, for example based on the presence of noise which can be higher or lower in the various areas or sections of a network which might be very complex and wide. In the situation represented in Fig. A, it has been established that the downlink path is formed by the sequence of the following nodes: N10, N9, N8....N1.. collecting unit.

This means the message generating node knows that its message is not sent directly to the collecting unit but rather to node N10. The message generated by

the message generating node includes the final address of the collecting unit and the address of the preferred downlink node N10. The message is thus transmitted to node N10. That node N10 receives the message and understands that (a) it is the intended downlink node for the message coming from the message generating node and (b) the message is not directed to itself but rather to the collecting unit. Any other node such as, for example, the node labeled N12 which could receive the message generated by the message generating node sees from the content of the message that it is not the intended intermediate node along the downlink path. The node N12 will therefore do nothing.

The process is repeated by node N10. The preferred downlink node for node N10 is node N9. Node N10 generates a new message which is not an echo of the original message from the message generating node but rather a different one. The difference between the received message for node N10 and the message generated by node N10 and intended to be transmitted to node N9 is the addressee of the intermediate downlink node.

In the original message, the downlink address was that of node N10. However, the message generated by node N10 includes as the address of the downlink node that of the subsequent node N9 along the preferred downlink path N10-N1. If a different node such as node labeled N13 receives the message generated by node N10, it will do nothing. Only the intended intermediate addressee, namely node N9, will act upon the received message. That node N9 will

understand that the message is intended for the collecting unit and must be therefore transmitted downwards.

Node N9 knows that downlink path goes through nodes N8. Therefore, node N9 will generate a new message (**not** an echo of the previous one) which is addressed to node N8. Any other node such as, for example, node N14 which by chance receives a message generated and transmitted by node N9 will do nothing. Only node N8 will act upon this new message. The process is repeated for each and every one of the node N8, N7,... N1. This latter node transmits the message directly to the collecting unit, which is the intended final recipient.

It is quite clear from the above explanation that for the Robinton protocol to properly operate, a preliminary network condition assessment step must be performed, such that each node knows which is the preferred along the downlink path.

According to Robinton the reverse situation is quite similar. Once the collecting unit has received the message, it will transmit a response message to the original message-generating node along the same path, now an uplink path, defined by nodes N1, N2...N10, with a reverse process.

A different process is depicted in Fig. B, i.e. the transmission protocol of the present invention. The message generating node (at the top of the drawing) intends to transmit a message to the collecting unit. The message contains only the address of the message generating node and the address of the collecting unit, but no

address of any intermediate node. There is no uplink or downlink path established in the network.

The message generated by the message generating node is transmitted on the power supply line. Assume that for whatever reason that message will only reach a limited number of nodes of the system, namely those included within the dashed line of Fig. B and labeled as nodes NA, NB, NC, ND, NE and NF. Each of those nodes acts in the same manner. It receives the message and understands that it is not the intended recipient, because the message is addressed to the collecting unit. As a consequence, each of nodes NA, NB, ... NF will generate an echo of the received message, i.e. a copy of that message.

For the sake of simplification, consider only the echo generated by node NF. Further assume that the echo of the message generated by node NF reaches further nodes in the system, namely those included within the continuous line represented in the drawing, being labeled from NG to NS. Each of those nodes will again understand that the received message is not intended for itself but addressed to the collecting unit. As a consequence, these nodes will start generating echoes of the message.

Now assume that the echo generated by the node NQ reaches as far as the collecting unit. The collecting unit receives the message and generates a response. The response includes the address of the message-generating node and certain information, including, for example, a flag which characterizes the message as being a response to the message generated by the message-generating node. The message

generated by the collecting unit is propagated in the same manner along the power supply line by subsequent echoes. If all of the nodes NG-NS receive the responding message, they understand that such message is a response to the previously transmitted one. They therefore stop generating echoes of the message received by the message-generating node and start transmitting echoes of the responding message generated by the collecting unit. These echoes will then reach further nodes, for example node NE, which will again start generating echoes of the responding message and so on until the responding message reaches the message generating node.

If for whatever reason one of the nodes in the system does not receive the responding message from the collecting unit, for example, because a section of the power supply line is broken, it will continue generating echoes until the echo preventing criteria are not met anymore. At that instant in time, that node will stop generating echoes of the responding message.

From the above explanation the conceptual difference between the claimed and Robinton systems is apparent. The Office Action confuses the echo of a message with the generation of a different message from one of the intermediate locations on the preferred path between the message-generating node and the collecting unit (see sketch of Fig. A).

There is another difference between the Robinton system and the claimed invention. This further difference has been recognized by the Examiner. Page 5, first paragraph of the Office Action states that Robinton does not disclose how to

prevent unlimited echoes from being generated. The reason why this is not disclosed in Robinton is that Robinton does not generate echoes at all. Therefore, there is no reason for providing an echo limitation procedure.

The Office Action states that criteria to prevent unlimited generation of echoes of a given message is known, for example, from one of the two secondary references US 2003/0097482 to DeHart or US 2003/0103521 to Raphaeli. Applicant respectfully disputes this statement.

The Office Action cites paragraph 0022 of DeHart. This paragraph discloses in a very generic way a means for preventing collision between different messages generated by different devices connected to a transmission bus. It is further disclosed that if more devices attempt to access a transmission bus, only the fastest device will be able to transmit its message, while the remaining devices will remain inactive or will interrupt the transmission of their messages. In other words, once the transmission bus is engaged by the message of the fastest device, all the remaining devices will wait for a better chance.

A more detailed description of this procedure is contained in paragraph 0074 of DeHart. Such a collision avoidance procedure doesn't pertain to criteria to prevent unlimited generation of echoes of a given message. The DeHart method does not provide for a device to start generating the echo of a given message for an unlimited or limited number of times. What is disclosed in the DeHart text cited in the Office Action is only a very trivial manner of avoiding corruption/collision of two messages simultaneously transmitted on the same bus by two different devices. To

prevent corruption which would result in a meaningless message, the slowest device will refrain from transmitting its message on the bus, waiting for the fastest device to complete its transmission.

Raphaeli also fails to disclose the generation of echoes and any criteria to prevent unlimited echo generation. The Office Action cites paragraph 0256 of Raphaeli. Applicant respectfully submits that this is an incorrect interpretation of the text, as there is no suggestion of use of a criterion to prevent unlimited generations of echoes. Raphaeli actually discloses how to prevent a single device from generating an unlimited number of messages addressed to the same addressee which does not respond. Raphaeli simply discloses that if the device A wants to communicate with the device B but fails to reach that device after a certain number of attempts, it will simply stop trying again.

A combination of Raphaeli and Robinton would result in the following: If, referring for example to Fig. A, the node N10 is incapable of transmitting its message to the downlink node N9, for example, because the connected line is broken, after a certain number of attempts node N10 will stop trying to contact node N9 and will select a different resource on the network, for example node N14, and will try to downlink the message through node N14. This has nothing to do with the claimed echo propagation concept that has been explained above with reference to Fig. B.

In summary, neither in Robinton nor in Raphaeli is there any disclosure of a plurality of nodes generating echoes of a message which is not intended to for those nodes but rather to a different node located further away.

Conclusion

Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and Applicant hereby reserves the right to present additional distinctions as appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

Pursuant to 37 C.F.R. § 1.136(a), Applicant requests an extension of time for responding to the Office Action for two months from August 27, 2010, to October 27, 2010. Applicant authorizes the Commissioner to charge Deposit Account No. 23-0035 in the amount $490.00 for the petition fee.

The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Response to Deposit Account 23-0035.

Respectfully submitted,

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